

**Technical and Professional
Education**

**Curriculum Content Frameworks for
Industrial Equipment
Maintenance**

**Curriculum Content Frameworks for
Industrial Equipment Maintenance
Developed by the
University of Arkansas at Little Rock**

**State of Arkansas
Department of Workforce Education**

NOTICE TO THE READER

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Preface

The Technical & Professional Education program continues to prepare students for employment and continuing education. To accomplish this preparation, teachers and employers have collaborated to modify individual programs to ensure that instruction is current and comprehensive. This document reflects essential competencies for program completers as well as All Aspects of the Industrial Equipment Maintenance Industry as required by the Carl D. Perkins Act. The Curriculum Content Frameworks for all Technical & Professional Education programs can be accessed through the Department of Workforce Education Web site.

Forward

The curriculum content framework *Industrial Equipment Maintenance* supports the course that prepares students for the following career roles, which in turn correspond to the CIP (Classification of Instructional Programs) codes listed below. The courses may be sequenced with a variety of career and technical courses to form a specialization to prepare students for careers and support additional education and training in the protective services industry.

The most specific level in the family structure, representing a Classification of Instructional Program (CIP) code and title, and identifying either an occupational title or an instructional program The instructional framework for Industrial Maintenance Technology supports the courses that prepare students for the following career roles, which in turn correspond to the CIP (Classification of Instructional Programs) codes listed below.

- Career Family: Manufacturing
- Career Area: Industrial Technology & Maintenance
- Career Role CIP Code
- Industrial Electronics Technology/Technician 470105
- Mechanics Maintenance Technology 470303
- O-NET – 49.9043.XX

Acknowledgments

The Industrial Equipment Maintenance curriculum content framework was produced by a team of program developers from the University of Arkansas at Little Rock. The framework was reviewed by a panel of experts in the field of Industrial Equipment Maintenance. The format and content of the framework reflect the specific training needs within the state of Arkansas. The framework content and format is modeled after a document originally developed by a writing team under the auspices of the Virginia Department of Education. Grateful appreciation is expressed to the Virginia Department of Education for granting the Arkansas State's Department of Workforce Education access to their instructional frameworks.

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Introduction

About the Program

This framework has been developed for use in designing and implementing a competency-based program in Industrial Equipment Maintenance. Contents of the document are presented in three major sections.

About the Document

This document includes the following components:

- Section 1 contains a master duty/task list for the Industrial Equipment Maintenance program.
- Section 2 contains an analysis of each task, consisting of the task, task definition, and process/skill questions to evaluate acceptable performance. All tasks have been designated essential. Essential tasks are those that must be achieved by every student pursuing the completion of the Industrial Equipment Maintenance program.
- Section 3 lists the Arkansas Standards of Learning for language arts, mathematics, and science that are reinforced by instruction in the Industrial Equipment Maintenance program. Academic skills in these areas are necessary for the mastery of a number of tasks performed by auto body technicians on the job.

Program Description

47.105 – Industrial Equipment Maintenance I

47.107 – Industrial Equipment Maintenance II

Industrial Equipment Maintenance prepares students for careers in manufacturing industries. The course sequence includes instruction for occupations dealing with the process of creating intermediate and finished products beginning with raw materials; it also includes managing, planning, and performing the production of various items by operating machinery, as well as industrial support activities such as production planning and control and maintenance. Students may combine the course with a variety of other approved offerings in the areas of leadership or information technology.

Master Duty/Tasks Listing

Industrial Equipment Maintenance I

Industrial Equipment Maintenance II

National and state experts in the occupational field of Industrial Equipment Maintenance have validated the duties and tasks in this section. Each is analyzed by identifying the following:

- a *duty/task statement*, which describes what the student is to do

DUTY A: Practicing Safety
Task:
A001: Explain the importance of safety.
A002: Demonstrate lifting and carrying techniques.
A003: Demonstrate ladder use techniques.
A004: Practice fire safety.
A005: Identify safe hand tool practices.
A006: Identify personal safety practices.
A007: Identify safe working practices related to the use of power tools.
A008: Demonstrate lockout/tagout procedures.
A009: Explain safe working practices around electrical hazards.
A010: Demonstrate safe housekeeping procedures.
A011: Comply with OSHA and EPA regulations for a safe work site.
A012: Identify emergency first aid procedures.

A013: Demonstrate safe machine shop practices.
A014: Demonstrate safe welding shop practices.
DUTY B: Performing Mathematical Calculations Related to Measurement
Task:
B001: Perform calculations using fractions.
B002: Convert between fractions and decimals.
B003: Compare numbers and calculate ratios.
B004: Use geometric functions.
B005: Perform algebraic equations.
B006: Apply trigonometric functions.
B007: Make metric measurements and conversions.
B008: Make linear measurements accurately to 1/16".
B009: Use a micrometer to measure accurately to .001".
B010: Use a dial caliper to measure accurately to .001".
B011: Use combination squares and protractors.
B012: Use a height gauge and surface plate to lay out and measure parts.

B013: Use inside micrometers and telescoping gauges.
B014: Use thread pitch, drill point, center, and radius gauges.
B015: Calculate speeds and feeds for machine tools.
DUTY C: Demonstrating Mechanical Skill with Hand and Power Tools
Task:
C001: Select appropriate hand tools.
C002: Cut stock accurately with a hand hacksaw.
C003: Use a file to de-burr, radius, and chamfer parts.
C004: Use punches and chisels properly.
C005: Cut internal and external threads with hand tools.
C006: Remove damaged screws with easy-outs.
C007: Use fixed and adjustable reamers.
C008: Thread pipe with hand tools.
C009: Select appropriate power tools.
C010: Use light-duty and heavy-duty drills.
C011: Use reciprocating saws, circular saws, and chop saws.
C012: Use hand grinders.

C013: Use power sheet metal shears.
C014: Use a bench grinder to sharpen punches, chisels, drill bits, and other cutting tools.
C015: Use a hydraulic press.
C016: Use a drill press.
C017: Use a band saw.
C018: Identify types of metals.
C019: Use power-driven pipe threaders.
DUTY D: Maintaining Systems
Task:
D001: Demonstrate knowledge of hydraulic system operation.
D002: Interpret diagrams and schematics for hydraulic systems.
D003: Install hydraulic system components.
D004: Apply preventive maintenance measures for hydraulic systems.
D005: Inspect and troubleshoot hydraulic systems.
D006: Demonstrate knowledge of pneumatic system operation.
D007: Interpret diagrams and schematics for pneumatic systems.
D008: Install pneumatic system components.
D009: Apply preventive maintenance measures for pneumatic systems.

D010: Inspect and troubleshoot pneumatic systems.
D011: Demonstrate knowledge of electrical system operation.
D012: Interpret diagrams and schematics for electrical systems.
D013: Install electrical system components.
D014: Apply preventive maintenance measures for electrical systems.
D015: Inspect and troubleshoot electrical systems.
D016: Demonstrate knowledge of mechanical system operation.
D017: Interpret diagrams and schematics for mechanical systems.
D018: Install mechanical system components.
D019: Apply preventive maintenance measures for mechanical systems.
D020: Inspect and troubleshoot mechanical systems.
DUTY E: Performing Milling Operations
Task:
E001: Mill stock to size.
E002: Indicate a vise.
E003: Use a center finder.
E004: Drill and ream holes.

E005: Drill a bolt circle using a digital readout system.
E006: Use a rotary table.
E007: Use a dividing head.
E008: Use a boring head.
E009: Cut angles using a sine bar.
DUTY F: Performing Turning Operations
Task:
F001: Use carbide and HSS cutting tools.
F002: Use a three-jaw chuck.
F003: Use a four-jaw chuck.
F004: Use a collet chuck.
F005: Turn stock between centers.
F006: Use a follow rest.
F007: Use a steady rest.
F008: Cut a short taper using the compound rest.
F009: Cut a taper using the taper attachment.
F010: Use a parting tool.
F011: Use a boring bar.

F012: Cut external threads.
F013: Drill holes using straight and taper shank drills.
DUTY G: Performing Welding Operations
Task:
G001: Demonstrate knowledge of welding processes.
G002: Perform visual inspection of welds.
G003: Perform oxyfuel cutting operations.
G004: Perform SMAW welding operations.
G005: Perform GMAW welding operations.
G006: Perform FCAW welding operations.
G007: Perform GTAW welding operations.
DUTY H: Working with Technical Drawings
Task:
H001: Interpret assembly drawings.
H002: Interpret building diagrams (including site plans).
H003: Develop sketches (including isometric and orthographic).
H004: Compute materials from drawings.
H005: Use a CAD program to create sketches.

DUTY I: Practicing Quality Control
Task:
I001: Apply TQM techniques.
I002: Demonstrate knowledge of ISO quality standards.
I003: Maintain inventory.
DUTY J: Exploring Careers
Task:
J001: Investigate careers in the industrial maintenance field.
J002: Participate in the co-curricular student organization activities

Task Definitions

National and state experts in the occupational field of Industrial Equipment Maintenance have validated tasks in this section. Each task is analyzed by identifying the following:

- a *task definition* (criteria for acceptable performance), which explains what the student has to do to perform the task at the expected level of mastery
- *process/skill questions*, which assess student knowledge and performance.

Tasks are arranged by instructional duty area only. The placement of tasks into specific courses and the sequencing of tasks for instruction are local decisions based on student needs, employer demand, and school schedules.

DUTY A: Practicing Safety
Task:
<p>A001: Explain the importance of safety.</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • explain reasons safety is important • explain key factors involved with safe work practice • explain types and effects of legal and illegal drugs in accordance with industry standards and instructor guidelines <p>Process/Skill Questions:</p>
<p>A002: Demonstrate lifting and carrying techniques</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • lift with legs • keep back straight • hold load close to the body • get help if necessary <p>Process/Skill Questions</p>
<p>A003: Demonstrate ladder use techniques</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • inspect, setup, and use single, step, extension, and other types of ladders in accordance with government regulations, industry standards, and instructor guidelines. <p>Process/Skill Questions</p>

A004: Practice fire safety

Definition: Process should include the following:

- identify classes of fires (A, B, C, D)
- identify causes and prevention of fires
- identify types and uses of fire extinguishers
- demonstrate fire extinguisher use, in accordance with government regulations and instructor's guidelines

Process/Skill Questions

A005: Identify safe hand tool practices

Definition: Process should include the following:

- use proper tool for the job
- use tools in good condition
- use tools correctly
- maintain tools
- store tools in accordance with industry standards, manufacturer's specifications, and instructor guidelines

Process/Skill Questions

A006: Identify personal safety practices

Definition: Process should include the following:

- use of safety glasses, goggles, hard hats, safety harnesses, work gloves, safety shoes, ear protection, proper clothing, no jewelry, respiratory protective equipment
- exhibit safe work attitudes in accordance with industry standards, manufacturer's specifications, and instructor guidelines

Process/Skill Questions

A007: Identify safe working practices related to the use of power tools

Definition: Process should include the following:

- select proper electrical, pneumatic, or hydraulic power tools for the job
- assure tools are in good working condition
- use safe working practices for each power tool in accordance with industry standards, manufacturers' specifications, and instructor guidelines

Process/Skill Questions

A008: Demonstrate lockout/tagout procedures

Definition: Process should include the following:

- identify different types of lockout/tagout equipment
- explain proper lockout/tagout procedures according to industry standards and instructor guidelines

Process/Skill Questions

A009: Explain safe working practices around electrical hazards

Definition: Process should include the following:

- identify equipment used to test electrical circuits
- describe safe working conditions
- demonstrate safe work habits according to industry standards and instructor guidelines

Process/Skill Questions

A010: Demonstrate safe housekeeping procedures

Definition: Process should include the following:

- remove unused items from work space
- provide adequate lighting for work area
- clean spilled liquids from work area
- store cleaners, solvents, and lubricants according to label instructions
- store oily rags or oily waste in proper lid-closing containers
- match colors of safety color codes with their uses according to industry standards, manufacturer specifications, and instructor guidelines

Process/Skill Questions

A011: Comply with OSHA and EPA regulations for a safe work site

Definition: Process should include the following:

- list OSHA and EPA regulations for the work site
- identify classified locations
- attend or conduct regular safety meetings
- identify MSDS for properly handling of hazardous materials in accordance with government regulations and instructor's guidelines

Process/Skill Questions

A012: Identify emergency first aid procedures

Definition: Process should include the following:

- identify first aid procedures for accidents involving body fluids, electrical injuries, eye injuries, falls, sprains and strain of limbs, and burns according to standard first aid and school policies

Process/Skill Questions

A013: Demonstrate safe machine shop practices

Definition: Process should include the following:

- wear proper work attire such as eye and hearing protection
- adhere to equipment operating standards
- perform equipment safety inspections
- follow OSHA, EPA, NIMS guidelines concerning the use, storage, and disposal of hazardous materials
- prepare time or job cards, reports, and records
- perform housekeeping duties on a daily basis according to local ordinances and instructor's guidelines

Process/Skill Questions

A014: Demonstrate safe welding shop practices

Definition: Process should include the following:

- wear proper work attire such as eye and hearing protection
- adhere to equipment operating standards
- perform equipment safety inspections
- follow OSHA, EPA, AWS guidelines concerning the use, storage, and disposal of hazardous materials
- prepare time or job cards, reports, and records
- perform housekeeping duties on a daily basis according to local ordinances and instructor's guidelines

Process/Skill Questions

DUTY B: Performing Mathematical Calculations Related to Measurement
Task:
B001: Perform calculations using fractions <i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • Calculate using addition, subtraction, multiplication, and division of fractions, particularly when performing measurements and reading blueprints Process/Skill Questions
B002: Convert between fractions and decimals <i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • perform measurements and read blueprints • use a calculator to convert fractions to decimals and decimals to the nearest fraction of an inch as read from a machinist's scale Process/Skill Questions
B003: Compare numbers and calculate ratios <i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • determine gear ratios (i.e., the ratio of drive to driven members) and pulley speeds • compare numbers to determine whether ratios are over- or under-driven Process/Skill Questions
B004: Use geometric functions <i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • perform lay out or setup to calculate measurements such as angles, linear distances, volume, perimeter, diameter, and circumference Process/Skill Questions
B005: Perform algebraic equations <i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • demonstrate ability to use algebra to solve problems related to inventory, time, and production management Process/Skill Questions

B006: Apply trigonometric functions

Definition: Process should include the following:

- determine height of a stack of gauge blocks necessary to achieve a given angle when combined with a sine bar or sine table
- determine set and run of a pipe fitting problem
- apply trigonometric functions to other related situations as deemed necessary by
-

Process/Skill Questions

B007: Make metric measurements and conversions

Definition: Process should include the following:

- convert to inch-based measurements
- make linear measurements with metric measuring tools
- convert between metric and U.S. systems

Process/Skill Questions

B008: Make linear measurements accurately to 1/16"

Definition: Process should include the following:

- measure a machined part using a six-inch steel rule with 1/16" gradations
- record dimensions appropriately as if performing an inspection
-

Process/Skill Questions

B009: Use a micrometer to measure accurately to .001"

Definition: Process should include the following:

- measure parts or gauge blocks accurately using a micrometer equipped with a vernier
- record dimensions as if performing an inspection

Process/Skill Questions

B010: Use a dial caliper to measure accurately to .001"

Definition: Process should include the following:

- measure length, depth, and inside and outside dimensions of a machined part accurately using a dial caliper
- record dimensions as if performing an inspection

Process/Skill Questions

B011: Use combination squares and protractors

Definition: Process should include the following:

- measure and lay out angles and dimensions using squares and protractors

Process/Skill Questions

B012: Use a height gauge and surface plate to lay out and measure parts

Definition: Process should include the following:

- set up and properly use a height gauge, surface plate, and gauge blocks (if necessary) to measure and/or lay out a part as directed

Process/Skill Questions

B013: Use inside micrometers and telescoping gauges

Definition: Process should include the following:

- use an inside micrometer and telescoping gauges with appropriate outside micrometer
- measure various size borings in engine blocks or other parts
- determine taper and out-of-round conditions compared to nominal bore sizes gleaned from specifications

Process/Skill Questions

B014: Use thread pitch, drill point, center, and radius gauges

Definition: Process should include the following:

- use various types of standard gauges such as thread pitch, drill point, center, and radius gauges to measure, inspect, or setup tools and parts

Process/Skill Questions

B015: Calculate speeds and feeds for machine tools

Definition: Process should include the following:

- use a chart of cutting speeds for various materials
- calculate rpm and feed rates for machine tools
- determine machining time based on removing a given amount of stock to form a part according to a print

Process/Skill Questions

DUTY C:
Demonstrating Mechanical Skill with Hand and Power

Task:

C001: Select appropriate hand tools

Definition: Process should include the following:

- identify, select, and use the appropriate hand tools for given application to include hammers, screwdrivers, torx, square, hex drive tools, ratchets & sockets (metric and standard, shallow & deep, various drive sizes), drive tools, impact tools, pliers, vise grip tools, plumbing wrenches, and specialty tools

Process/Skill Questions

C002: Cut stock accurately with a hand hacksaw

Definition: Process should include the following:

- identify metal
- select blade
- follow safety guidelines
- ensure accuracy

Process/Skill Questions

C003: Use a file to de-burr, radius, and chamfer parts

Definition: Process should include the following:

- identify files and make appropriate selections for a given filing task
- de-bur parts
- cut radii and chamfers on mechanical components

Process/Skill Questions

C004: Use punches and chisels properly

Definition: Process should include the following:

- identify and use punches and chisels to include center, prick, pin, transfer, and alignment
- select cold chisel size, use, and proper sharpening technique

Process/Skill Questions

C005: Cut internal and external threads with hand tools

Definition: Process should include the following:

- identify thread size designations and tap drill sizes
- select threads and taps for a given task
- perform drilling and tapping of threads
- identify correct use of different taps including pipe, starting, plug, and bottoming taps
- identify correct use of various types of dies to cut and chase threads

Process/Skill Questions

C006: Remove damaged screws with easy-outs

Definition: Process should include the following:

- determine removal technique to includes tool selection, drilling and application of heat according to instructor direction

Process/Skill Questions

C007: Use fixed and adjustable reamers

Definition: Process should include the following:

- identify various types of fixed and adjustable reamers
- ream holes to a specified size and finish

Process/Skill Questions

C008: Thread pipe with hand tools

Definition: Process should include the following:

- identify and use various types of fixed and adjustable tapered pipe thread dies to properly thread pipe
- select and use appropriate lubricants

Process/Skill Questions

C009: Select appropriate power tools

Definition: Process should include the following:

- identify, select, and use the appropriate power tools for a given application based on tool availability, safety, quality, and accuracy of work being performed

Process/Skill Questions

C010: Use light-duty and heavy-duty drills

Definition: Process should include the following:

- drill a variety of materials such as light- and heavy-gauge ferrous and non-ferrous metals, plastics, and wood using drill types to include cordless, masonry, variable-speed, and heavy-duty

Process/Skill Questions

C011: Use reciprocating saws, circular saws, and chop saws

Definition: Process should include the following:

- select appropriate saw for desired application
- select blades for use on different materials including wood, metal, and masonry
- change blades and service equipment periodically

Process/Skill Questions

C012: Use hand grinders

Definition: Process should include the following:

- select appropriate grinding wheels for various applications
- inspect wheels routinely
- service equipment

Process/Skill Questions

C013: Use power sheet metal shears

Definition: Process should include the following:

- cut sheet metal in a safe manner
- adjust blades as needed
- perform routine service of equipment

Process/Skill Questions

C014: Use a bench grinder to sharpen punches, chisels, drill bits, and other cutting tools

Definition: Process should include the following:

- select grind stones for various applications
- sharpen punches, chisels, drill bits, and other cutting tools
- change and dress wheels as needed

Process/Skill Questions

C015: Use a hydraulic press

Definition: Process should include the following:

- press bearings and shafts
- service equipment.

Process/Skill Questions

C016: Use a drill press

Definition: Process should include the following:

- perform various operations, such as drilling, reaming, countersinking, and counter boring holes
- demonstrate proper setup and clamping techniques
- drill holes in metal, wood, and plastic accurately

Process/Skill Questions

C017: Use a band saw

Definition: Process should include the following:

- select blades for various applications
- cut metal or wood stock
- change coolant and blades as needed
- service equipment routinely

Process/Skill Questions

C018: Identify types of metals

Definition: Process should include the following:

- conduct visual inspections and spark testing, that yield information (i.e., properties of given materials such as weight, strength, corrosion resistance) to consider when selecting materials for various maintenance applications such as repairing or fabricating mechanisms

Process/Skill Questions

C019: Use power-driven pipe threaders

Definition: Process should include the following:

- select proper cutting fluid
- thread pipe with a power threader
- service equipment routinely

Process/Skill Questions

DUTY D:
Maintaining Systems

Task:

D001: Demonstrate knowledge of hydraulic system operation

Definition: Process should include the following:

- understand physical laws governing water flow, phenomena such as hydraulic transmission of force and energy and control of hydraulic energy, and components of hydraulic systems including pumps and valves
- demonstrate an understanding of maintenance measures that ensure trouble-free operation

Process/Skill Questions

D002: Interpret diagrams and schematics for hydraulic systems

Definition: Process should include the following:

- know meanings of abbreviations and symbols
- comprehend related mathematics
- understand blueprint layout and assembly standards
 - read and calculate measurements
 - determine symbols' relationships to other elements in the diagram or schematic
 - follow instructions, specifications, and notes to explain the operation of, make material lists for, and troubleshoot the depicted system

Process/Skill Questions

D003: Install hydraulic system components

Definition: Process should include the following:

- identify system components and their functions
- remove pressure from the system
- remove and install valves, pumps, and lines
- check the system for leaks

Process/Skill Questions

D004: Apply preventive maintenance measures for hydraulic systems

Definition: Process should include the following:

- understand purpose of preventive maintenance
- know which equipment parts require regular checks
- focus attention on safety issues
- adhere to an analysis guide
- produce an inspection report

Process/Skill Questions

D005: Inspect and troubleshoot hydraulic systems

Definition: Process should include the following:

- inspect system visually to determine cause of problem and include use of a troubleshooting chart and follow established procedures to resolve problem

Process/Skill Questions

D006: Demonstrate knowledge of pneumatic system operation

Definition: Process should include the following:

- understand physical laws governing air flow, phenomena such as pneumatic transmission of force and energy and control of pneumatic energy, and components of pneumatic systems including pumps and valves
- demonstrate understanding of maintenance measures that ensure trouble free operation

Process/Skill Questions

D007: Interpret diagrams and schematics for pneumatic systems

Definition: Process should include the following:

- know meanings of abbreviations and symbols
- comprehend related mathematics
- understand blueprint layout and assembly standards
 - read and calculate measurements
 - determine symbols' relationships to other elements in the diagram or schematic
 - follow instructions, specifications, and notes to explain operation of, make material lists for, and troubleshoot depicted system

Process/Skill Questions

D008: Install pneumatic system components

Definition: Process should include the following:

- remove pressure from the system
- remove and install valves, pumps, and lines
- check system for leaks

Process/Skill Questions

D009: Apply preventive maintenance measures for pneumatic systems

Definition: Process should include the following:

- understand preventive maintenance's purpose
- know which equipment parts require regular checks
- attend to safety issues
- adhere to analysis guide
- produce an inspection report

Process/Skill Questions

D010: Inspect and troubleshoot pneumatic systems

Definition: Process should include the following:

- inspect system visually to determine cause of given problem and use troubleshooting chart and follow established procedures to resolve problem

Process/Skill Questions

D011: Demonstrate knowledge of electrical system operation

Definition: Process should include the following:

- understand laws governing electricity; the relationship between voltage, current, and resistance; and circuits and other electrical devices
- demonstrate an understanding of maintenance measures that ensure trouble-free operation

Process/Skill Questions

D012: Interpret diagrams and schematics for electrical systems

Definition: Process should include the following:

- know meanings of abbreviations and symbols
- comprehend related mathematics
- understand blueprint layout and assembly standards
 - identify components in a circuit
 - read and calculate measurements
 - determine symbols' relationships to other elements in the diagram or schematic
 - follow instructions, specifications, and notes to explain operation of, make material lists for, and troubleshoot depicted system

Process/Skill Questions

D013: Install electrical system components

Definition: Process should include the following:

- select type conduit and/or wire support system
- determine correct angle of bend for assigned task, fabricate bend with correct tool, and mount conduit using correct fasteners
- assemble raceways and mounting
- use knockouts to connect conduit to raceways or electrical panels in accordance with NEC, manufacturer's specifications, and common trade practices

Process/Skill Questions

D014: Apply preventive maintenance measures for electrical systems

Definition: Process should include the following:

- understand purpose of preventive maintenance
- know which equipment parts require regular checks
- attend to safety issues
- adhere to analysis guide
- produce inspection report

Process/Skill Questions

D015: Inspect and troubleshoot electrical systems

Definition: Process should include the following:

- inspect system visually to determine cause of problem
- use troubleshooting chart
- follow established procedures to resolve problem

Process/Skill Questions

D016: Demonstrate knowledge of mechanical system operation

Definition: Process should include the following:

- understand physical laws governing mechanical systems, phenomena such as transmission of force and energy and control of energy, and components of mechanical systems
- demonstrate understanding of maintenance measures that ensure trouble-free operation

Process/Skill Questions

D017: Interpret diagrams and schematics for mechanical systems

Definition: Process should include the following:

- know meaning of abbreviations and symbols
- comprehend related mathematics
- understand blueprint layout and assembly standards
 - read and calculate measurements
 - determine symbols' relationships to other elements in diagram or schematic
 - follow instructions, specifications, and notes to explain operation of, make material lists for, and troubleshoot depicted system

Process/Skill Questions

D018: Install mechanical system components

Definition: Process should include the following:

- prepare area for installation
- position and secure machinery
- align components
- connect system to power source

Process/Skill Questions

D019: Apply preventive maintenance measures for mechanical systems

Definition: Process should include the following:

- understand purpose of preventive maintenance
- know which equipment parts require regular checks
- attend to safety issues
- adhere to analysis guide
- produce inspection report

Process/Skill Questions

D020: Inspect and troubleshoot mechanical systems

Definition: Process should include the following:

- inspect system visually to determine cause of problem
- use troubleshooting chart
- follow established procedures to resolve problem

Process/Skill Questions

DUTY E:
Performing Milling Operations

Task:

E001: Mill stock to size

Definition: Process should include the following:

- determine speed and feed method
- cut stock to specified dimensions using various cutters (e.g., endmills, facemills, flycutters)
- use micrometer dials to cut stock to size
- perform climb and regular milling operations
- demonstrate knowledge of coolants

Process/Skill Questions

E002: Indicate a vise

Definition: Process should include the following:

- use dial indicator and align holding attachments to make a vise parallel to direction of table travel

Process/Skill Questions

E003: Use a center finder

Definition: Process should include the following:

- use center finder to locate center of a mark for drilling stock

Process/Skill Questions

E004: Drill and ream holes

Definition: Process should include the following:

- demonstrate knowledge of milling machines, power feeds, drill bit speeds, reamers, lubricants, and coolants

Process/Skill Questions

E005: Drill a bolt circle using a digital readout system

Definition: Process should include the following:

- know digital readout system, use tools for layout, and methods of layout

Process/Skill Questions

E006: Use a rotary table

Definition: Process should include the following:

- know rotary table and centering techniques, types of machines used with rotary table, applications of rotary table, and index plate

Process/Skill Questions

E007: Use a dividing head

Definition: Process should include the following:

- know dividing head and centering techniques, types of machines for use with dividing head, applications of dividing head, and index plate

Process/Skill Questions

E008: Use a boring head

Definition: Process should include the following:

- know boring head and centering techniques, types of machines for use with boring head, applications of boring head, and index plate

Process/Skill Questions

E009: Cut angles using a sine bar

Definition: Process should include the following:

- determine height of a sine bar setting for a given angle

Process/Skill Questions

**DUTY F:
Performing Turning Operations**

Task:

F001: Use carbide and HSS cutting tools

Definition: Process should include the following:

- follow manufacturer's and classroom specifications
- know speed and feed methods, carbide cutting tools, and geometries to specific jobs

Process/Skill Questions

F002: Use a three-jaw chuck

Definition: Process should include the following:

- follow manufacturer's and classroom specifications
- select and install chuck jaws for various applications involving turning of round or hexagonal stock

Process/Skill Questions

F003: Use a four-jaw chuck

Definition: Process should include the following:

- follow manufacturer's and classroom specifications
- select and install chuck jaws for various applications involving turning of round, square, rectangular, or odd-shaped stock

Process/Skill Questions

F004: Use a collet chuck

Definition: Process should include the following:

- follow manufacturer's and classroom specifications
- select and install collets for various applications involving turning of round, square, hexagonal, or octagonal stock

Process/Skill Questions

F005: Turn stock between centers

Definition: Process should include the following:

- follow manufacturer's and classroom specifications
- select and install drive plates, sleeves, centers, and drive dogs and locating centers of stock

Process/Skill Questions

F006: Use a follow rest

Definition: Process should include the following:

- follow manufacturer's and classroom specifications
- bolt the follow rest to the carriage
- make adjustments for turning of long, thin pieces of stock

Process/Skill Questions

F007: Use a steady rest

Definition: Process should include the following:

- follow manufacturer's and classroom specifications
- bolt steady rest to ways
- make adjustments for turning of long, thin pieces of stock

Process/Skill Questions

F008: Cut a short taper using the compound rest

Definition: Process should include the following:

- follow manufacturer's and classroom specifications
- convert taper to degrees and measure angles
- mount work between centers or in a chuck
- set cutting tool for an internal or external cut
- feed cutting tool with both hands

Process/Skill Questions

F009: Cut a taper using the taper attachment

Definition: Process should include the following:

- follow manufacturer's and classroom specifications
- convert taper to degrees and measuring angles
- set attachment
- mount work by any conventional means
- set cutting tool for an internal or external cut

Process/Skill Questions

F010: Use a parting tool

Definition: Process should include the following:

- follow manufacturer's and classroom specifications
- set up parting tool to cut off stock
- determine speed and feed method
- set clearance
- apply cutting fluid
- sharpen parting tool

Process/Skill Questions

F011: Use a boring bar

Definition: Process should include the following:

- follow manufacturer's and classroom specifications
- choose boring bar that corresponds to hole size to be bored
- determine speed and feed method

Process/Skill Questions

F012: Cut external threads

Definition: Process should include the following:

- follow manufacturer's and classroom specifications
- use threading tool and centering gauge
- set lathe to cut a specified thread
- calculate depth of cut
- apply cut fluid
- check threads

Process/Skill Questions

F013: Drill holes using straight and taper shank drills

Definition: Process should include the following:

- follow manufacturer's and classroom specifications
- specify dimensions
- set up tail stock
- determine speed
- choose method for holding drill
- drill pilot hole, if necessary

Process/Skill Questions

**DUTY G:
Performing Welding Operations****Task:****G001: Demonstrate knowledge of welding processes**

Definition: Process should include the following:

- interpret symbols and drawings
- identify various welding equipment
- perform various welding processes
- demonstrate knowledge of electrical terms and theory related to welding
- identify various applications of welding

Process/Skill Questions

G002: Perform visual inspection of welds

Definition: Process should include the following:

- examine material surfaces visually for serious notches, grooves, or gouges
- inspect visually tacks, intermediate layers, and completed welds for defects and discontinuities (e.g., undercut, slag inclusion, and overlap) in accordance with the instructor's guidelines

Process/Skill Questions

G003: Perform oxyfuel cutting operations

Definition: Process should include the following:

- place equipment in operation
- perform minor repairs
- select proper operating pressures, tips, and filler rods
- set up and use a manual oxyfuel cutting torch to cut carbon steel
- fusion weld carbon steel sheet metal without filler rod
- weld butt and lap joints on steel sheet metal and tubing with filler rod
- braze single and multi-pass joints on steel and cast iron

Process/Skill Questions

G004: Perform SMAW welding operations

Definition: Process should include the following:

- place equipment in operation
- perform minor repairs
- select machine settings
- select electrodes
- perform fillet and groove welds in flat, horizontal, and vertical positions
- perform single- and multiple-pass welds with organic and low hydrogen electrodes in flat, horizontal, and vertical positions

Process/Skill Questions

G005: Perform GMAW welding operations

Definition: Process should include the following:

- place equipment in operation
- perform minor repairs
- select machine setting electrodes, and shielding gas
- perform fillet and groove welds in flat, horizontal, and vertical positions using GMAW-S
- perform fillet and groove welds in flat, horizontal, and vertical positions using GMAW spray transfer

Process/Skill Questions

G006: Perform FCAW welding operations

Definition: Process should include the following:

- place equipment in operation
- perform minor repairs
- select machine setting, electrodes, and shielding gas
- perform fillet and groove welds in flat, horizontal, and vertical positions using FCAW-S

Process/Skill Questions

G007: Perform GTAW welding operations

Definition: Process should include the following:

- perform minor repairs
- select machine setting, electrodes, and shielding gas
- perform fusion welds of aluminum, stainless steel, and carbon steel
- perform flat groove welds and horizontal fillet welds on aluminum, stainless steel, and carbon steel

Process/Skill Questions

**DUTY H:
Working with Technical Drawings****Task:****H001: Interpret assembly drawings**

Definition: Process should include the following:

- identify parts and associated part numbers
- identify order of operation in assembly/disassembly
- disseminate title block information

Process/Skill Questions

H002: Interpret building diagrams (including site plans)

Definition: Process should include the following:

- identify systems such as plumbing, HVAC, and electrical
- identify basic building features such as doors, windows, rooms, hallways, stairs, loading docks
- identify features such as contour, landscape, traffic issues, drainage, utilities

Process/Skill Questions

H003: Develop sketches (including isometric and orthographic)

Definition: Process should include the following:

- develop three-view sketch of an object using appropriate drafting conventions and symbols such as various line types, dimensioning techniques, and proper views
- develop isometric sketches from orthographic views
- sketch both orthographic and isometric views of objects that solve mechanical problems such as brackets, mounts, and parts of mechanisms
- sketch objects from oral descriptions

Process/Skill Questions

H004: Compute materials from drawings

Definition: Process should include the following:

- view drawing of an object or assembly and developing a bill of materials required to fabricate item
- know standard dimensions for given material (e.g., 4' x 8' sheets of plywood, 1" round stock x 20' lengths) and allowance for loss of materials and hardware

Process/Skill Questions

H005: Use a CAD program to create sketches

Definition: Process should include the following:

- develop sketches with basic drawing tools and appropriate geometry
- solve problems such as layout
- design fitting parts for fabrication

Process/Skill Questions

**DUTY I:
Practicing Quality Control****Task:****I001: Apply TQM techniques**

Definition: Process should include the following:

- incorporate feedback with the four categories of Total Quality Management (TQM)
 - planning (i.e., identifying and researching problem)
 - doing (i.e., developing a solution)
 - checking (i.e., confirming results of solution)
 - acting (i.e., documenting results and making recommendations),to ensure structured approach to improving quality of products and services

Process/Skill Questions

<p>I002: Demonstrate knowledge of ISO quality standards</p> <p>Definition: Process should include the following:</p> <ul style="list-style-type: none"> • understand ways ISO standards can be applied to industrial maintenance <p>Process/Skill Questions</p>
<p>I003: Maintain inventory</p> <p>Definition: Process should include the following:</p> <ul style="list-style-type: none"> • use computerized systems to track data related to products, materials, equipment, purchasing, cataloging, and distribution <p>Process/Skill Questions</p>
<p>DUTY J: Exploring Careers</p>
<p>Task:</p>
<p>J001: Investigate careers in the industrial maintenance field</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • use Internet, magazines, books, and other resources to research characteristics, skills, benefits, and occupations found in industrial maintenance <p>Process/Skill Questions</p>
<p>J002: Participate in the co-curricular student organization activities</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • participate in SkillsUSA–VICA activities to include attending meetings, being involved in projects and activities, and competing in events <p>Process/Skill Questions</p>

SkillsUSA

DUTY A: Self - Improvement
Task:
A001: Complete a self-assessment and identify individual learning styles <i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • Identify and list individual strengths. • Identify and list areas in need of improvement. Process/Skill Questions
A002: Discover self-motivation techniques and establish short-term goals <i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • Develop a list of short-term goals. • Discuss ways to change or improve lifestyle appearance and behavior. Process/Skill Questions
A003: Determine individual time-management skills <i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • Prepare and keep a time journal. • Discuss ways to improve time management skills. Process/Skill Questions
A004: Define future occupations <i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • Search internet for career opportunities within specified fields of study. • Prepare presentation on a specified career area. Process/Skill Questions
A005: Develop awareness of cultural diversity and equity issues <i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • Research a tradition modeled by individual's family. • Develop personal philosophy statements regarding gender equity. Process/Skill Questions

<p>A006: Define the customer</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Differentiate between External and Internal customers • Discuss factors which contribute to poor customer relationships. <p>Process/Skill Questions</p>
<p>A007: Recognize benefits of doing a community service project</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Discuss and list ways to become involved in the community • Develop a community service project. <p>Process/Skill Questions</p>
<p>A008: Demonstrate effective communication with others</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Identify and list personal barriers to listening. • Develop personal plan to overcome barriers to listening. <p>Process/Skill Questions</p>
<p>A009: Participate in a shadowing activity</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Summarize experience of job shadowing activity. <p>Process/Skill Questions</p>
<p>A010: Identify the components of an employment portfolio</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Identify parts of a portfolio • Design a personal employment portfolio <p>Process/Skill Questions</p>
<p>A011: List proficiency in program competencies</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Complete an interpersonal competency assessment. <p>Process/Skill Questions</p>
<p>DUTY B: Civic, Social and Business Awareness</p>
<p>Task:</p>

<p>B001: Measure/modify short-term goals</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Discuss steps to pursue short-term goal(s) <p>Process/Skill Questions</p>
<p>B002: Identify stress sources</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • List personal sources of stress. • Discuss techniques to cope with individual sources of stress. <p>Process/Skill Questions</p>
<p>B003: Select characteristics of a positive image</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Discuss actions and traits that lead to a positive image. • Discuss actions and traits that lead to a negative image. <p>Process/Skill Questions</p>
<p>B004: Demonstrate awareness of government, professional organizations and trade unions</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Identify state governor, legislators, and senators. • Identify professional organizations pertaining to specific career areas. <p>Process/Skill Questions</p>
<p>B005: Apply team skills to a group project</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Form a team to develop a class project. <p>Process/Skill Questions</p>
<p>B006: Observe and critique a meeting</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Attend a formal meeting held within the community • Critique the attended meeting. <p>Process/Skill Questions</p>
<p>B007: Demonstrate business meeting skills</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • List and discuss the basic rules to ensure an orderly and business-like meeting

<ul style="list-style-type: none"> • Role-play appropriate meeting skills <p>Process/Skill Questions</p>
<p>B008: Demonstrate social etiquette</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Role-play appropriate social behavior • Differentiate between good and bad manners. <p>Process/Skill Questions</p>
<p>B009: Complete survey for employment opportunities</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Gather information on a particular employment opportunity of interest. • Conduct internet search of a specific career area. <p>Process/Skill Questions</p>
<p>B010: Review a professional journal and develop a 3 to 5 minute presentation</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Develop a presentation on the content, purpose, and distribution of a particular professional journal <p>Process/Skill Questions</p>
<p>B011: Identify customer expectations</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • List and discuss customer expectations. • Discuss consequences of unmet customer expectations. <p>Process/Skill Questions</p>
<p>B012: Complete a job application</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Obtain a job application from various businesses in the community • Conduct a mock job interview. <p>Process/Skill Questions</p>
<p>B013: Identify a mentor</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Define mentor. • Discuss ways in which a mentor can help an individual meet career goals.

Process/Skill Questions
<p>B014: Assemble your employment portfolio</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Develop employment portfolio <p>Process/Skill Questions</p>
<p>B015: Explore supervisory and management roles in an organization</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Examine an organizational chart • Discuss responsibilities of managers and supervisors <p>Process/Skill Questions</p>
<p>B016: Recognize safety issues</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Discuss safety issues within a given career area <p>Process/Skill Questions</p>
<p>B017: Evaluate your proficiency in program competencies</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Define task and competency • List competencies associated with a specified career area. <p>Process/Skill Questions</p>

Technical And Professional Curriculum Frameworks

Purpose

This section of the framework contains material to help instructors in technical and professional programs to reinforce basic skills in the areas of Reading and Writing, Math and Science. The technical portion of this guide takes a more direct approach by using specific duty and task listings, but changes in the academic section lead in a more general direction. The reason for this is simple: all good instructors do not teach in the same way. However, all good instructors share the trait of being able to connect their material to everyday life. For example, understanding concepts related to heat, are important for cosmetology students as well as lathe operators in manufacturing plants. However, each program will probably take a different approach in the amount of detail and examples relating to heat concepts. Both groups require basic science knowledge of principles relating to heat, but the application of the principles will be different.

Basic Skills: The Content Areas

Included in this guide are materials to support basic skills in Reading and Writing, Mathematics, and Science. The overall approach taken here is a move toward problem-solving skills. By problem-solving, we mean the ability to take information and use it for a purpose: to take action, make decisions, predict outcomes, suggest improvements. Another term for these thinking skills is a general “literacy.”

Literacy skills have always been in demand in the workplace. A quick review of workplace training programs and other literature regarding adult education demonstrates that the need for a literate workforce is still one of the most pressing problems employers face today. Indeed, many employers (from small- and medium-sized businesses to Fortune 500 companies) have spent hundreds of millions of dollars on in-house basic skills training programs.

What constitutes a literate workforce? There are many definitions for literacy and hundreds of tests that measure it, but when employers are asked what they're looking for in potential new hires, the answers are general: they want individuals who can read and write; show up on time; think and solve problems, and keep their personal lives in order (that is, don't bring a drinking problem into the workplace).

Viewed in this way, the words "literacy" and "literate" are good terms for what educators are trying to instill in their students, the future workforce. The more common definition (being able to read and write) is certainly appropriate but the additional definitions (knowledgeable, educated, well-informed) are also apt. It is this broad term, "literate," that we use to guide instructors on what to cover in the classroom. No matter which vocational-technical area is being focused on, no matter how technical the terminology is, instructors are given the task of helping students take information, break it down into necessary parts, process details, and be able to come away with an understanding of some sort. This is "literacy", and the process is the same for every subject area-- teaching students how to think and solve problems.

Format

Each section includes a two-column table. Skills are listed on the left side; suggestions for implementing these skills into the curriculum are listed on the right side. Each suggestion is written in such a way that it can be tailored to most vocational-technical programs.

Using The Guide

This guide was prepared with four concepts in mind:

- The instructor is *aware of the need* for students to improve their basic skills.
- The instructor is the *best-qualified person* to decide how to include this material in the classroom or lab. The students' abilities and needs should drive the instructor in deciding how to use, expand, or modify these topics.
- The instructor *already has curriculum that works* for his or her students. Therefore, the suggestions for reinforcing basic skills
 - must be easy to implement
 - must stand alone

- do not need to be taught in a particular order
 - must be open-ended enough to be useful for any technical/vocational program.
- ***Time is limited.*** Unless there are quick ways to reinforce basic skills, changes to the curriculum will not be made. Teaching basic skills in the context of technical material will help students make connections that are more memorable, and will require no additional lesson planning. Just as instructors incorporate updates in technical knowledge, they can add basic skills concepts as well. Adding a few concepts at a time will help students perform better in the lab as well as on tests and evaluations.

Methods

The following methods may help instructors decide how to increase basic skill knowledge:

- *Collaborative projects*- how could a joint project between regular education teachers and vocational instructors reinforce concepts for both programs?
- *Outside assignments*- would students benefit from an outside assignment explaining how a basic math (science, reading) concept ties to a process in the lab?
- *Extra credit*- students needing extra credit can research outside topics and turn in a short summary of material
- *“Need-to-know” assignments*- Students prepare a bulleted list of the basic concepts in science they need to know in order to correctly perform ____ operation in the lab.
- *Question of the Day*- a few daily math problems for students to answer at the beginning of class allows the instructor to set the tone for the material. It also gives students an immediate goal when they enter the classroom and teaches them to stay on task. Bonus points may be awarded at the end of the week, quarter, semester, etc.
- *Two-minute Oral Presentations*- students who need to practice speaking skills can be asked to give a two-minute oral presentation at the end of class summarizing the main points for the day. Or, a two-minute presentation at the beginning of class can recap the material from a previous class.
- *Connecting with Workers*- students can poll parents, friends, area employers or other persons to find out the top 5 basic science skills needed on the job.

- *Direct Questioning*- include a few basic knowledge questions in a presentation. Award points to groups based on correct answers.

Resources

In creating the Academic Reinforcement material for the technical and professional frameworks, we used a number of source documents and resources.

- The English Language Arts, Science, and Mathematics components of the *Curriculum Improvement Project* by Dr. Willard Daggett were consulted to ensure that the top-ranked skills in those areas would be reflected in the academic support material. The English Language Arts and Science components have many linkages to the material included here. (The higher-level math skills such as trigonometry were not included in this document.)
- Data from work with Arkansas employers- the Workplace Skills Enhancement Program (WSEP) at the University of Arkansas at Little Rock (UALR) has completed many training projects and job profiles for employers in Arkansas. Our constant contact with workers and employers provides a tremendous amount of data that we use in designing customized training programs and in working on projects such as curriculum frameworks. Also, the staff of WSEP has experience teaching in Arkansas public schools, the US military, and the Job Corps.
- Additionally, other groups within UALR (the Labor Education Program, the Institute for Economic Advancement and the College of Business) provide resources regarding health and safety information, labor unions and their role in the workplace, computer and information technology and other training and outreach program data.
- US Department of Labor- the US DOL has many online documents and publications that support workers and issues regarding the workplace. (Work by Philippi and Greenan, 1988 on workplace skills was especially helpful.) Visit the website at www.dol.gov.
- Occupational Safety and Health Administration (OSHA) provides online and other resources for instructors and professionals. For topics relating to safety and health, visit www.osha.gov.

- Multistate Academic and Vocational Curriculum Consortium (MAVCC) is an organization that develops competency-based curriculum. For more on MAVCC see www.mavcc.org.

ACADEMIC STANDARDS FOR READING AND WRITING

Strategies for Reinforcement in the Vocational-Technical Classroom

Note:

* indicates industry-related materials, handouts, notes, etc.

Objective	Classroom Applications to Industry
<p><i>Present,</i> <i>Review and Discuss,</i> <i>Master</i> the list of skills employers want for the workplace regarding reading and writing.</p>	<p>Use the list of skills employers want to introduce students to the requirements of the workplace.</p> <p>Depending on students' ability levels, any of the following methods may be used to increase their understanding of the concepts:</p> <ul style="list-style-type: none"> • Discussion • Interviewing parents or other adults in the workplace about the skills required • Interviewing employers about the skills in terms of importance • Identifying workplace situations in which certain skills become more important than others • Researching adult education programs to learn why deficits in these areas must be remediated, and the cost spent yearly on these programs • Researching the topic of adult literacy
<p><i>Answer</i> simple comprehension or recall questions from a lecture or from written material.</p>	<p>Provide 2 examples of workplace materials* on students' reading level.</p> <p>With the first, allow students to read information and then answer brief recall questions.</p> <p>With the second example, read aloud the material but do not give a handout. Ask brief recall questions.</p> <p>Compare the differences...how do students retain information better—orally or visually? Discuss learning styles and impact on the job.</p>
<p><i>Follow,</i> <i>Give</i> oral instructions.</p>	<p>Using instructions for a hands-on task, have students give <u>oral</u> instructions to a partner or group. Rate the effectiveness of the speaker.</p>

<i>Follow,</i> Give written instructions.	Using a short list of instructions for a hands-on task, have students give <u>written</u> instructions to a partner or group. Rate the effectiveness of the speaker.
Show the difference between relevant and irrelevant details.	Using a copy of workplace materials*, students underline relevant or important details in red, irrelevant or less important details in blue.
Sort objects based on x number of criteria.	Using workplace materials*, sort a group of objects based on characteristics identified by instructor (e.g., by color, shape, defect, or a combination of these).
<i>Recognize,</i> Identify technical vocabulary.	Using workplace materials*, highlight technical vocabulary terms. Create a class dictionary of industry-related technical vocabulary. Students may add illustrations or diagrams. Each student receives a copy of the final product. Emphasize skills such as alphabetical order, guidewords, prefixes, suffixes, and pronunciation guides.
Read aloud.	Read aloud from workplace materials* in groups or individually.
Identify, Explain symbols, abbreviations and acronyms relevant to subject area.	Using workplace materials*, highlight symbols, abbreviations, and acronyms. Create a table with one column for each of symbols, abbreviations, acronyms. Classify each one and write in the meaning.
Understand, Use rules of grammar, usage, spelling, punctuation.	Identify the missing punctuation mark, misspelled word, incorrect use of grammar from workplace materials*. Correct the mistakes.
Discuss <u>uses and purposes</u> of a variety of workplace communication tools.	Find examples of a business letter, memo, report, brochure, proposal, schematic, map, and diagram.
Duplicate process demo by instructor	Using a workplace process, demonstrate steps

	to complete and have students perform individually or in groups.
<i>Notice,</i> Apply word analysis techniques.	Using workplace materials*, identify prefixes, suffixes, or roots that indicate meaning (e.g. therma = heat) ¹
Match parts from photographs or diagrams to actual objects.	Using workplace materials*, follow a sequence of pictures or diagrams to build, create, or copy an item or process.
Read for main ideas and for details.	Use a graphic organizer ¹ to show main ideas and supporting details.
Distinguish between fact, opinion, and inference.	Collect examples of materials based on fact or opinion/inference. Ask students to underline key terms that indicate the presence of facts or opinions.
Distinguish between rows and columns; identify a cell as a block where a row and column intersect.	Using charts or tables from workplace materials*, discuss the reasons for this format. Identify the quantity in a particular cell.
<i>Select,</i> Use appropriate resources and reference tools.	Explain the uses for the following: Dictionary, Thesaurus, Almanac, Atlas, Card Catalog, Encyclopedia. List reasons for choosing one reference tool over another. Use reference tools to answer questions related to industry or current events.
Paraphrase written or oral material into summary form.	Using workplace materials*, determine the best way to condense or shorten the material so as to give an overview to a layperson. Using a set of guidelines appropriate to students' level in length and detail, summarize the information into bullet points.

<p><i>Interpret,</i> <i>Fill out/complete</i> forms and records.</p>	<p>Using workplace materials*, answer basic questions (e.g., summarize the list of parts from an inventory).</p> <p>Using blank forms or documents, fill in details. Pay close attention to directions. Students critique work with partner.</p> <p>Create a form or document to be used in a workplace process.</p>
<p><i>Use,</i> <i>Develop</i> a process for remembering details.</p>	<p>Use pneumatic devices to organize and remember details. Pneumatic devices¹ include Semantic Maps, Thought Webs, and other creative tools to organize thinking.</p>
<p><i>Proofread,</i> <i>Correct</i> mistakes in written drafts.</p>	<p>Using a newspaper article, locate and mark mistakes in grammar, punctuation, or usage.</p> <p>Correct mistakes in written drafts.</p>
<p><i>Examine</i> different types of writing used in the workplace (reports, memos, brochures, logs, blueprints, formulas, etc).</p>	<p>Gather samples of workplace materials*. Identify each by type.</p> <p>Compare and contrast the difference between audience, (who the document is written for) length, background information/education needed to understand material, level of detail, organization and layout of the document.</p>
<p><i>Understand</i> the writing process.</p>	<p>In order to apply the writing process, create a workplace communication tool to be used for a specific purpose.</p> <p>Prewrite: Brainstorm, gather facts, or do research to create a <u>business letter, memo, report, brochure, proposal, schematic, map, or diagram.</u></p> <p>Identify the audience.</p>

	<p>Determine the purpose of the document.</p> <p>Write: Create a first draft.</p> <p>Revise and Edit: Make changes to ensure accuracy.</p> <p>Look at the writing from a different point of view.</p> <p>Shorten or make more concise where possible.</p> <p>Use white space, bold print and other formatting details to make the document easy-to-read.</p> <p>Publish: Decide on the best format for the final copy (size, type of material, layout, graphics, etc.)</p> <p>Publish the final draft.</p>
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<p><i>Identify,</i> Create sentences of different types.</p>	<p>Using workplace materials*, find sentences of varying types. Examples include Simple Sentences (subject + predicate) Complex Sentences (subject + predicate including clauses).</p> <p>Write sentences, paragraphs, or essays using sentences of different types (e.g., write a 2-paragraph summary of today's lesson).</p>
<p><i>Identify,</i> Use contractions correctly.</p>	<p>Using workplace materials*, locate contractions (e.g., isn't, I'll).</p> <p>Identify misuses of contractions.</p> <p>Write a short list of directions relating to an industry process and use as many contractions as possible.</p>
<p><i>Identify,</i> Use correctly commonly misspelled words.</p>	<p>Using a list of commonly misspelled words¹, locate errors in the media (newspaper articles, Internet sites, magazines.)</p> <p>Ask each student to identify his problem words from the list.</p> <p>Attempt to incorporate problem words into class activities (e.g., add them to a list of work instructions).</p> <p>Give short weekly quizzes focusing on 5 words per week. Award bonus points.</p>
<p><i>Identify,</i> Use correctly the English irregular verbs.</p>	<p>From a list of irregular verbs, review the uses of each.</p> <p>Ask each student to identify his problem irregular verbs from the list.</p> <p>Attempt to incorporate problem verbs into class activities, such as making a collection of mistakes from print.</p>
<p><i>Identify,</i> Use Signal Words and other cues to improve writing.</p>	<p>Use a list of Signal Words¹ and discuss their purpose in writing (signal words are words that raise a flag to a reader to pay attention.)</p>

	<p>Examples: Signal Words showing emphasis: Most of all, It should be noted, Of course</p> <p>Signal Words showing a conclusion: Lastly, In summary, Finally</p> <p>Identify common signal words in workplace writing, especially in sequenced lists.</p> <p>Write a list of work instructions using signal words.</p>
Identify components of workplace documents such as blueprints, schematics, floor plans, and other industry-related documents.	Label the parts of a workplace document.
Place steps in proper sequence.	Using a list of steps or pictures cut them apart so that students can place them in the proper order.
Analyze cause and effect.	Experiment with cause and effect in the classroom (e.g., change the sequence of events in a process).
Determine missing information.	<p>Locate the information that is missing from a problem and explain why the problem cannot be solved without it.</p> <p>To reinforce concepts, use a completed problem and remove the important details. Ask students if they can identify what's missing.</p>
Differentiate between tools used for a job.	Given a list of tools and a list of functions, identify the most efficient tool for each task.
Assemble or disassemble objects.	<p>From a list of oral or written instructions, assemble an object or complete a process.</p> <p>Students write the instructions for disassembly.</p>
Cross-reference materials to compare information.	Using more than one source document, compare the information given.

<i>Interpret reasoning behind rules or regulations.</i>	Using workplace materials*, make a list of possible reasons or justifications for a safety guideline, regulation, etc.
<i>Show contrasts between approaches.</i>	<p>Given a workplace scenario, write a brief approach to solving the problem. (Working in groups would be beneficial.)</p> <p>Compare and contrast each approach from the perspective of a worker, manager, supervisor.</p>
<i>Organize data in a new format.</i>	Using workplace materials*, organize the information into a new format.
<i>Prove a rule or method's sufficiency.</i>	Perform an experiment to determine how much tolerance is acceptable in a case study, (e.g., find the range of drops of red dye sufficient to match the standard red color used in latex paint).
<i>Show relationships between two or more systems.</i>	Using 2 or more partners related to industry, show or explain how they are interrelated (e.g., explain the relationship between social workers and hospitals).
<i>Given examples of emergency situations, identify real world course of action.</i>	Using an emergency situation common to your industry, outline a step-by-step plan for action.
<i>Identify variables that affect the outcome of a process.</i>	Experiment with or predict variables that affect the outcomes for a process (e.g., weather patterns that adversely affect a process, such as building a road).
<i>Infer situations that meet guidelines when complete information is not available.</i>	<p>Given a policy or industry standard that has debatable interpretations, list possible situations that can arise that do not have clear solutions in the policy.</p> <p>Discuss or debate the issues.</p>
<i>Compare finished products to a set of guidelines.</i>	Compare a set of objects to a set of guidelines (e.g., analyze a batch of parts and document how they do or do not meet a set of Quality Assurance guidelines).

	List any discrepancies (parts that do not meet guidelines) and categorize them by type (e.g., burns, holes, etc).
<i>Identify preventative measures for maintenance of a system.</i>	List the needed routine maintenance to keep a system working properly.
<i>Predict new standards or rules that may become necessary in the future.</i>	Identify recent areas of change or development in your industry. Discuss potential future needs or developments that may occur (e.g., potential need for better training requirements for airport personnel).
<i>Improve a process by streamlining (locating waste) or decreasing lost time.</i>	Examine a process in industry in step-by-step detail. Suggest ways to decrease time needed or make the process more efficient. Isolate the cause of failure in a process by performing an experiment.
<i>Prepare a model explaining a concept.</i>	Build, draw, or create a model that explains a concept (e.g., show a need for environmental standards for water or air pollution).

¹ Fry, Edward; Kress, Jacqueline; Fountoukidis, Dona. *Reading Teacher's Book of Lists*, 4th ed. ISBN 0-13-028185-9.

ACADEMIC STANDARDS FOR MATHEMATICS

Strategies for Reinforcement in the Vocational-Technical Classroom

Note:

* indicates industry-related materials, handouts, notes, etc.

Topics Listing

Problem Solving

Operations and Calculations

Applications

Data Analysis and Display

Objectives	Classroom Applications to Industry
<p><i>Present</i> <i>Review and Discuss</i> Master the list of skills employers want for the workplace regarding mathematics.</p>	<p>Use the list of skills employers want to introduce students to the requirements of the workplace.</p> <p>Depending on students' ability levels, any of the following methods may be used to increase their understanding of the concepts:</p> <ul style="list-style-type: none"> • Discussion • Interviewing parents or other adults in the workplace about the skills required • Interviewing employers about the skills in terms of importance • Identifying workplace situations in which certain skills become more important than others • Researching adult education programs to learn why deficits in these areas must be remediated, and the cost spent yearly on these programs • Researching the topic of adult literacy
PROBLEM SOLVING	
<p><i>Examine</i> Apply problem-solving process.</p>	<p>Define the problem What is being asked? Decide on a type of solution Multi-step or single-step question? Try any of these: Estimate an answer Draw a diagram Find a pattern</p>

	<p> Guess and check Logical Reasoning Make a graph Make an organized list Make a table Solve a simpler problem Use a simulation Work backwards Write an equation </p> <p> Locate information you need Do you have all the components? </p> <p> Get missing information May need to perform some other calculations </p> <p> Calculate Look at the answer. How should the remainder be expressed? </p> <p> Check the solution Is it reasonable? </p>
OPERATIONS AND CALCULATIONS	
<i>Read, write, and count numbers.</i>	<p>Read and write numbers (especially focus on very large and very small numbers where mistakes are common).</p> <p>Give a weekly quiz asking students to compare and sequence numbers. Example: 0.4445 ____ 0.4455 > or <</p> <p>Put these in order from smallest to largest: 0.66, 0.677, 0.67</p>
<i>Round numbers.</i>	<p>Discuss your industry's use of decimals.</p> <p>Identify the place values needed to adequately perform a job. For example, a Quality Assurance Technician who works on the line in a manufacturing plant may need to use numbers through the ten-thousandths decimal place.</p>

	Take a series of sample measurements, and round them to the nearest decimal place identified by the instructor.
<i>Estimate numbers.</i>	<p>The skill of making close estimations is tied to understanding accuracy.</p> <p>Discuss real-life situations where estimation is used.</p> <p>Discuss the practice of estimation before calculation. Regular practice in estimating before calculating will teach students where they make errors and will increase their estimation skills.</p> <p>Discuss work situations where estimation skills are required, and possible consequences of making estimation errors (for example, is an estimate appropriate for inventory purposes? For ordering supplies?)</p>
<i>Compute averages.</i>	<p>Discuss averages in general terms. Calculate the average temperature, average rainfall or precipitation, average number of students per class, and other relevant examples.</p> <p>Using workplace materials*, calculate a series of averages.</p> <p>For example:</p> <ul style="list-style-type: none"> • Take 10 different measurements of a piece of pipe using a micrometer. • Compare the measurements. • Find the average of all the measurements. • Compare the average to the smallest and largest measurement. • Discuss the effects on quality...when is an average an acceptable benchmark measurement?
<i>Calculate with whole numbers: perform one-step problems with basic operations.</i>	Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles of addition, subtraction, multiplication, and division.
<i>Perform problems that require an</i>	Using workplace materials*, make a list of

<p>understanding of the order of operations.</p>	<p>situations or problems that need more than one step to perform them.</p> <p>If the procedures (add, subtract, multiply, divide, etc) are on the same level of importance, such as adding or subtracting, then the order of operations will not impact the way the problem is solved.</p> <p>If a problem requires more than one level of operation to solve (example, dividing and adding), work the problem correctly by performing the division part first and then the addition.</p> <p>Rework the problem using addition first. Compare the answers.</p> <p>Discuss the importance of reasoning skills to verify that an answer makes sense.</p>
<p><i>Understand the relationship between decimals, fractions and percents.</i></p>	<p>Make a table comparing fractions, decimals, and percents.</p>
<p><i>Compute with fractions, decimals, and percents, and show understanding of the relationship between them.</i></p>	<p>Create sample problems using fractions that relate to everyday situations.</p> <ul style="list-style-type: none"> ▪ Poll the class on interesting topics (favorite food). Convert whole numbers to fractions. Votes- Pizza- 10 Salad- 2 BBQ- 8 <p>$10+2+8 = 20$ (recognize denominator value)</p> <p>$\frac{10}{20}$ Pizza $\frac{2}{20}$ Salad $\frac{8}{20}$ BBQ</p> <ul style="list-style-type: none"> ▪ Add the fractions. <p>$\frac{10}{20} + \frac{2}{20} + \frac{8}{20} = \frac{20}{20}$</p> <ul style="list-style-type: none"> ▪ Convert fraction to whole number. (Total answers equal 1 class's worth of answers.)

	$\frac{10}{20} + \frac{2}{20} + \frac{8}{20} = \frac{20}{20} = 1$ <ul style="list-style-type: none"> Convert fractions to percents. $\frac{10}{20} \text{ means } 10 \text{ divided by } 20 = 0.50$ <p>Move decimal 2 places right. $0.50 = 50\%$</p> $\frac{2}{20} \text{ means } 2 \text{ divided by } 20 = 0.10$ <p>$0.10 = 10\%$</p> $\frac{8}{20} \text{ means } 8 \text{ divided by } 20 = 0.40$ <p>$0.40 = 40\%$</p> <p>$50\% + 10\% + 40\% = 100\%$ Notice the totals add to 100%.</p> <p>So, $\frac{20}{20} = 1 = 100\%$</p> <p>Using workplace materials*, calculate work-related questions using fractions, decimals, and percents.</p> <p>Calculate shipping costs for internet purchases (such as music from amazon.com).</p>
<i>Solve formulas and equations.</i>	<p>Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles of equations.</p> <ul style="list-style-type: none"> Work left to right Use order of operations Place numbers on one side, variables on the other side
<i>Obtain squares and square roots.</i>	<p>Review the methods for calculating squares, square roots, cubes, and cube roots. Use industry-related formulas to demonstrate examples.</p> <p>Compare the difference between the 2 common answers to 3^2 (answer = 9, not 6).</p>

	How would an incorrect value affect the work on the job?
Convert units of measure: <i>Recognize components of measuring systems (US and metric) for length.</i>	Discuss industry measures and terms relating to length.
Convert units of measure: <i>Recognize components of measuring systems (US and metric) for mass/weight.</i>	Discuss industry measures and terms relating to mass/weight.
Convert units of measure: <i>Recognize components of measuring systems (US and metric) for volume.</i>	Discuss industry measures and terms relating to volume.
<i>Measure with a certain degree of accuracy.</i>	<p>Estimate measurements.</p> <p>Using workplace materials* and tools, take measurements of work-related and classroom items.</p> <p>Depending on ability level, students may measure to the nearest foot, inch, centimeter, etc.</p>
APPLICATIONS	
<i>Solve word problems.</i>	Help students feel more comfortable with word problems by placing simpler problems in word problem form; or take concepts students have already mastered and ask them to write word problems for each other to solve.
<i>Select/apply mathematical formula.</i>	Review a set of math formulas and then a list of sample problems. Decide which formula(s) apply to each problem.
<i>Understand the importance of time in the workplace.</i>	Using workplace materials*, make a list of workplace scenarios that require using time correctly, such as keeping a time card, or heating a liquid solution for 20 minutes.
<i>Recognize components of time systems (clocks and calendars).</i>	<p>AM and PM</p> <p>Leap Year</p> <p>Military time</p>

<p><i>Discuss, Identify, Understand</i> terms relating to measuring time.</p>	<p>Discuss the units of time measurement and time vocabulary: second, minute, hour, day, week, month, year, leap year, fiscal year, quarter, annual, biannual, etc.</p>
<p><i>Understand</i> that time can be expressed in terms of equivalencies.</p>	<p>Show the time equivalencies using fractions. For example: $1 \frac{1}{2} \text{ days} = \underline{\hspace{1cm}} \text{ hours}$</p> $\begin{array}{rcl} 1 \text{ day} & = & 24 \text{ hours} \\ + \frac{1}{2} \text{ day} & = & \underline{+12 \text{ hours}} \\ 1 \frac{1}{2} \text{ days} & = & 36 \text{ hours} \end{array}$
<p><i>Compute</i> time conversions.</p>	<p>Make a table that shows the equivalencies of time units.</p> <p>Compute conversion problems at the appropriate level of difficulty. Examples include:</p> <ul style="list-style-type: none"> • Convert minutes to hours • Convert hours to days • Convert seconds to years.
<p><i>Calculate</i> ratio and proportion.</p>	<p>Review fractions when discussing ratio and proportion.</p> <p>Draw common classroom items to scale by finding a conversion rate (1 foot equals 1 inch).</p> <p>Make predictions using ratios. (If each student in class has 3 children, how many children will there be all together? Write the ratios.)</p>
<p><i>Apply</i> geometry principles: Use formulas for measuring shapes of 2 dimensions.</p>	<p>Determine the formulas that apply to 2 dimensions: perimeter, area, surface area, etc.</p> <p>Find perimeter of classroom. Discuss perimeter of objects that are not shaped as perfect squares. How does this change the formula for perimeter?</p> <p>Find the area of the tiles on the floor. Find the area of the classroom.</p>

	Review that all areas are expressed in terms of square units (square inches, square miles, etc)
<i>Apply geometry principles: Use formulas for measuring shapes of 3 dimensions.</i>	Review the formulas that apply to 3 dimensions of objects: volume. Find the volume of common objects such as soda cans, pizza boxes, etc. Review that volume is expressed in cubic units. Discuss industry-specific needs for these formulas; for example, find the volume of a tank or silo.
<i>Define terms relating to money.</i>	Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles relating to money. For more advanced students, include terms and principles of economics, finance, or statistics.
<i>Perform one-step problems involving money.</i>	Make change. Count up (rather than backwards) to make change.
<i>Perform multiple-step problems using money.</i>	Calculate gross and net earnings. Calculate <ul style="list-style-type: none"> ▪ Interest ▪ Sales tax ▪ Percent off ▪ Sale price ▪ Profit percentages Perform banking transactions.
<i>Perform business-related financial activities.</i>	At a level of complexity appropriate to your industry and to students' ability levels, solve income/expense problems, prepare budgets, etc.
<i>Use a calculator to perform computations.</i>	Identify appropriate activities that can be performed using a calculator (calculators

	<p>allow students to concentrate on problem-solving strategies.</p> <p>Award prizes for weekly activities or competitions.</p>
<i>Calculate measurements taken from measuring devices.</i>	Add, subtract, multiply and divide measurement numbers by plugging them into formulas.
<i>Perform/prepare an inventory.</i>	<p>Use a sample group of items to prepare an inventory.</p> <p>Review inventory vocabulary terms.</p> <p>Discuss the math processes that would apply to the inventory process.</p>
DATA ANALYSIS AND DISPLAY	
<i>Recognize types of visual representations.</i>	<p>Charts</p> <p>Graphs</p> <p>Tables</p>
<i>Interpret charts, graphs and tables.</i>	<p>Answer simple questions about charts, graphs and tables.</p> <p><i>Solve</i> multi-step problems involving the correlation of graphs and tables.</p>
<i>Collect/record data.</i>	<p>As appropriate to industry, practice sampling methods. Discuss safety precautions for sampling. Visit OSHA at the Department of Labor website for more details.</p> <p>Practice collecting and recording sample data from your industry (such as measurements taken using a micrometer). Compare class answers.</p> <p>Find the range of answers (maximum and minimum). Find the average.</p> <p>Discuss an acceptable range of answers (\pm), and graph the results showing the number that fell inside and outside the acceptable range.</p>

<i>Review and apply principles of probability.</i>	Use real-life examples that are highly motivating to direct the students' attention to probability principles. (Example, "I am thinking of a number between 1 and 50. The person who guesses the number will receive that many bonus points if she can tell me the probability of choosing the number correctly.")
Use probability models to predict chance events.	Calculate <u>theoretical probability</u> of an event (e.g., the probability of rolling a 5 on a die is $1/6$). Find <u>empirical probability</u> of an event by performing repeated experiments. Compare the 2 probabilities.
<i>Calculate and interpret statistics.</i>	Identify the importance of using statistics correctly. Bring examples of statistics from the news or media and analyze them: are they ambiguous? Are they correct? What data is the advertisement trying to get the public to see? For a humorous look at statistics, see <i>How to Lie with Statistics</i> by Huff and Geis.
<i>Interpret plans/blueprints.</i>	Review vocabulary and terms for plans, blueprints and schematics. Build a plan or blueprint one layer at a time, starting with the basic identifying information. Add layers of wax paper or other transparent drawing material on top of the first layer that allows each layer to be viewed individually, or the entire drawing as a whole.
<i>Construct charts and tables.</i>	Discuss chart types and chart vocabulary. Using workplace or sample data from the class, construct tables and charts.

	<p>For a daily example, consult <i>USA Today</i> online and look for the snapshots section that shows a graph of some sort. Ask weekly bonus questions about the data.</p> <p>Challenge students to bring in examples of charts and graphs containing errors.</p>
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ACADEMIC STANDARDS FOR SCIENCE

Strategies for Reinforcement in the Vocational-Technical Classroom

Note:

*** indicates industry-related materials, handouts, notes, etc.**

Topics Listing

General Science- topics not specific to a content area

Physical Science-

- Mechanics and Physics
- Energy and Waves
- Thermodynamics
- Electromagnetism
- Chemistry
- Optics

Life Science-

- Cell biology
- Evolution
- Genetics and Heredity
- Human and Animal Development

Anatomy

- Ecology
- Viruses
- Bacteria
- Plants

Earth Science-

- Earth in space
- Solar System/Astronomy
- Atmosphere and weather
- Oceans and water
- Earth resources

Note:

* indicates industry-related materials, handouts, notes, etc.

Objective**Classroom Applications to Industry**

GENERAL SCIENCE	
<p><i>Present,</i> <i>Review and Discuss,</i> Master the list of skills employers want for the workplace regarding science skills.</p>	<p>Use the list of skills employers want to introduce students to the requirements of the workplace.</p> <p>Depending on students' ability levels, any of the following methods may be used to increase their understanding of the concepts:</p> <ul style="list-style-type: none"> • Discussion • Interviewing parents or other adults in the workplace about the skills required • Interviewing employers about the skills in terms of importance • Identifying workplace situations in which certain skills become more important than others • Researching adult education programs to learn why deficits in these areas must be remediated; find out the cost to employers to educate adult workers • Researching the topic of adult literacy
<p><i>Perform</i> computations as required to solve problems.</p>	<p>Use the metric system to convert units of measure.</p> <p>Round numbers to correct number of significant figures.</p> <p>Determine percentage of error.</p> <p>Understand validity, reliability, accuracy, and precision.</p>
<p><i>Apply</i> scientific method of inquiry.</p>	<p>Identify the steps of the scientific method.</p> <p>Conduct experiments.</p> <p>Understand the following terminology: Conclusions vs inferences Variables Replications Samples/sample size</p>

<i>Investigate science history as it applies to industry.</i>	<p>In groups, research topics in science pertaining to your industry. Have students assign roles for each member of the group.</p> <p>Present findings in report format, or in oral presentations.</p> <p>Investigate science ethics.</p> <p>Recognize the processes available for accountability in industry. For example, OSHA has a Safety and Health Program Assessment Worksheet whereby employers can be rated for safety issues. See http://www.osha.gov/SLTC/safetyhealth_ecat/mo d3.htm</p> <p>[Note: Safety and Health is a mandatory subject of bargaining when a workplace is unionized; in both unionized and non-unionized workplaces, an employer cannot create and dominate workplace safety committees (see the National Labor Relations Act).]</p>
<i>Use scientific instruments to measure aspects of the environment.</i>	Gather data on time, length, mass, pressure, volume, acceleration or other measureables using instruments from the job.
<i>Demonstrate an understanding of data.</i>	<p>List the processes involved in gathering data.</p> <p>Suggest ways that data can be grouped or organized.</p> <p>Collect specimens.</p> <p>Show how data can be represented (graphically, charts and diagrams, etc)</p> <p>Construct a model to depict a basic concept.</p>
<i>Identify the seven basic S I (Systeme International) units.</i>	<p>Length- meter- m</p> <p>Mass- kilogram- kg</p> <p>Time- second- s</p> <p>Electric current- ampere- A</p>

	<p>Temperature- Kelvin- K Amount of substance- mole- mol Luminous intensity- candela- cd</p> <p>Dictionary of units- see http://www.ex.ac.uk/cimt/dictunit/dictunit.htm</p>
<i>Identify S I (Systeme International) Derived units.</i>	<p>Choose units appropriate to your industry (hertz, ohm, volt, watt, etc).</p> <p>Create a picture dictionary demonstrating the concepts.</p>
<i>Review relevant theories, laws and models.</i>	As relating to your industry, discuss important theories, laws and models.
<i>Use reference tools to solve problems.</i>	Use scientific reference tools (such as the Periodic Table of Elements) to learn more about specific industry concepts.
<i>Practice safe lab procedures.</i>	<p>Handle equipment with care.</p> <p>Demonstrate safety and first aid procedures.</p> <p>Identify harmful substances.</p>
PHYSICAL SCIENCE	
<i>Understand the cyclical nature of systems.</i>	<p>Show, demonstrate, model, track the cycles of any of the following systems:</p> <p>Growth and decay Food webs Weather Water</p>
<i>Analyze/classify matter according to type.</i>	<p>Identify types of matter (solids, liquids, gases). Which types are predominantly used in your area of industry?</p>
<i>Explain the concepts of work and power.</i>	<p>Identify machines used in industry.</p> <p>Identify how energy levels change when work or power is increased/decreased.</p> <p>Identify fuel sources used in your industry.</p> <p>Discuss internal and external combustion.</p>

	Create a model demonstrating the uses of levers and pulleys.
<i>Be familiar with concepts of motion.</i>	<p>Measure acceleration and deceleration</p> <p>Understand the relationship between speed and velocity by performing experiments.</p> <p>Recognize waves and vibrations as a type of motion.</p> <p>Understand action and reaction.</p> <p>Review laws pertaining to motion.</p>
<i>Understand concepts related to force.</i>	<p>Show the need for balance of forces acting on an object.</p> <p>Observe centrifugal and centripetal forces in action.</p> <p>Show how friction is created and must be accounted for in using and preserving equipment.</p> <p>Create a chart showing types of lubricants needed in a factory and schedule of maintenance.</p> <p>Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles of inertia.</p> <p>Show the relationship between pressure, mass, and weight.</p>
<i>Understand and apply principles relating to the atom.</i>	<p>Understand that atoms have a positive, negative or neutral charge. (Classify protons, electrons, and neutrons.)</p> <p>Identify ions.</p>
<i>Investigate forms of and changes in energy.</i>	<p>Discuss how energy is measured.</p> <p>Observe changes in energy relationships.</p> <p>Identify catalysts and reactants.</p>

	Identify sources of kinetic and potential energy in your industry.
<i>Discuss, apply principles of electricity and electric currents.</i>	<p>Identify types of circuits and switches.</p> <p>Show the difference between direct and alternating currents. Give examples of the best/most efficient use of each.</p> <p>Determine how electricity is measured, and solve problems using these terms. (Example, use Ohm's law to calculate current, resistance, and voltage.)</p> <p>Identify good conductors and insulators, and how to choose them.</p> <p>Understand grounding and create a visual display of grounding safety practices. Include the threat of static electricity.</p> <p>Show the uses of a vacuum tube by building a model.</p> <p>Compare the following ways of generating electricity: Hydroelectricity Motors Solar Power Steam/nuclear Transformers Incandescent (Light) Show the implications for your industry.</p> <p>As appropriate to your industry, identify electrochemical energy sources (cells, electrodes, batteries) and the processes of oxidation and reduction.</p>
<i>Be familiar with sound waves.</i>	<p>Compare how sound waves travel between liquids, solids, and air.</p> <p>Examine different types (lengths) of sound waves. Examine decibels safe for human hearing. Identify safety precautions for industry regarding sound tolerance.</p>

	<p>Be able to use correctly the terms below as they relate to your industry. (For example, ask students to write a short essay explaining a demonstration from class and include the following terms):</p> <p>Amplification Audible range Frequency Acoustics Resonance Speed</p>
<i>Be familiar with principles of heat.</i>	<p>Differentiate between the 3 types of heat transfer (conduction, convection, radiation).</p> <p>Understand that substances expand and contract due to heating and cooling</p> <p>Identify purpose and types of insulations used.</p> <p>Differentiate between heat and temperature.</p>
<i>Investigate and apply concepts relating to temperature.</i>	<p>Use the temperature scales; convert between Celsius and Fahrenheit.</p>
<i>Explain the concepts of magnetism.</i>	<p>Understand that currents create magnetic fields.</p> <p>Identify materials that are good conductors, and the properties that make them such.</p> <p>Understand electromagnetic forces present in earth.</p>
<i>Investigate/apply chemical properties.</i>	<p>Differentiate between acids and bases. Find pH for substances used in industry.</p> <p>Identify substances used in your industry and classify them by type.</p> <p>Name the major drugs, fertilizers, or additives used in your industry. Define and state examples of chemical reactions.</p> <p>Be familiar with solutions used in your industry. Compare saturated and unsaturated solutions. Determine whether a solution is soluble or insoluble.</p>

	Explain solute and solvent.
<i>Investigate forms of and changes in matter.</i>	<p>Compare and contrast physical and chemical changes.</p> <p>Discuss the types of physical or chemical changes that take place in your industry, from processing raw materials to manufacturing.</p>
<i>Understand and apply concepts relating to the elements.</i>	<p>Examine the 4 elements that make up 99% of living organisms (Hydrogen (H), Oxygen (O), Nitrogen (N), and Carbon (C)).</p> <p>Element Groups:</p> <ul style="list-style-type: none"> Alkali Metals Alkaline Earth Metals Transition Metals Other Metals Metalloids Non-Metals Halogens Noble Gases Rare Earth Elements
<i>Be familiar with principles of light.</i>	<p>Discuss light as a form of energy.</p> <p>Describe types of lighting systems.</p> <p>Examine the light spectrum and note the relative smallness of visible light.</p> <p>Define reflection and refraction.</p> <p>Explain how light carries information (by lasers) and show examples of the impact on technology/industry.</p> <p>Identify types of lenses.</p>
<i>Be familiar with principles of color.</i>	<p>Diagram the main parts of the eye involved in seeing color (rods, cones).</p> <p>Use prisms to split light into the visible spectrum. Briefly explore color blindness. What precautions should colorblind persons take regarding workplace safety?</p>

	Define situations in which colorblindness impacts a worker's ability to do his job.
LIFE SCIENCE	
<i>Explain the presence of cells as the identifier of all living organisms.</i>	<p>Examine the cells of organic material used in your industry, using books, the internet, or a microscope.</p> <p>Recognize that cells divide or replicate to promote growth of an organism.</p> <p>Examine the parts of a cell. Compare the cell to a machine...how do the parts function and rely on each other?</p> <p>Give example of one-celled and multiple-celled organisms.</p> <p>Review the classification system of all organisms (Kingdom, Phylum, etc).</p> <p>Create a circle graph or pie chart (totaling 100%) showing the relationship (in numbers) between the groups of organisms: Bacteria Fungi Viruses Insects Plants Vertebrates Invertebrates</p> <p>Compare some of the cell processes (active and passive transport) to the processes in your industry.</p>
<i>Understand the progress of evolution of organisms.</i>	Recognize how a species will adapt to better fit in its environment over time.
<i>Explain the role of genetics in human development.</i>	<p>Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles of heredity, including:</p> <ul style="list-style-type: none"> • Half of an individual's genes are contributed by each parent • Traits that are inherited are either dominant or recessive from the parent(s)

	<ul style="list-style-type: none"> • Cell division by mitosis versus meiosis • Disabilities are caused either by genetic/inherited conditions (such as Down's Syndrome) or in accidents occurring after birth, such as brain damage due to a car accident or a stroke
<i>Investigate/apply</i> principles of human development.	<p>Describe the life cycle of humans and other animals.</p> <p>Use the concept of human development to explain the need for understanding foundation skills in your area. (For example, children do not run before they walk.) Use this concept to explain other events that occur in a natural order in your industry.</p>
<i>Explore</i> additional concepts pertaining to humans and other animals.	<p>Give examples of ways organisms adapt to their environment.</p> <p>As relating to industry, review the concepts of:</p> <p>Aging Immune system Skin and Tissues Blood and hemoglobin Disease</p>
<i>Compare/contrast</i> the differences between sexual and asexual reproduction.	<p>Determine instances when understanding the concepts of sexual reproduction are important for your industry.</p> <p>Highlight the effects of unsafe working practices on unborn fetuses, or the dangers present for pregnant individuals working in industry.</p>
<i>Show</i> a general understanding of the importance of health.	<p>Explore the cost of lost wages and worker's compensation in the past year due to health problems.</p> <p>Research the most common health problems among workers (workers with safe jobs; workers with most hazards to health, etc)</p>
<i>Investigate</i> the food cycle.	<p>Identify food chains, food webs, food pyramids.</p> <p>Show how changes to the food cycle affect the</p>

	<p>environment and affect man.</p> <p>Name the food groups.</p>
<i>Understand</i> nutrition and the body's need for a diet that provides vitamins and minerals.	<p>Show an understanding of body systems (circulatory, nervous, digestive, etc) as they relate to industry.</p> <p>Identify deficient vitamins and minerals among a particular population (American workers, workers in specific environments, workers who do not go outdoors, or who always work outdoors) and the health risks associated with job types (office work, mining work, etc.)</p>
<i>Observe</i> health code/sanitation requirements.	<p>Research the development of health code and sanitation requirements, including OSHA.</p> <p>Compare/contrast workplaces of 1850, 1900, 1950, 2000 regarding health and safety.</p> <p>Discuss the most common workplace violations of health requirements and present in a graphic format (e.g., maps, charts).</p> <p>Discuss potential effects of ignoring health requirements.</p> <p>After identifying workplace hazards, create several plans to treat the problem. Debate the benefits of each.</p> <p>To avoid the threat of employers choosing ineffective means of ensuring safety on the job, locate MSDS sheets, first aid stations, personal protective equipment, worker's compensation claims offices/paperwork, etc.</p> <p>Using workplace materials*, locate the section on safety regulations. Ask students to rank order the items. Debate the importance of each. Determine the threat of ignoring regulations. Research which regulations are often disregarded.</p> <p>Explore proactive measures students can take to extend their health.</p> <p>Understand the importance of mental health in</p>

	addition to physical health.
<i>Investigate/apply</i> principles of anatomy and physiology.	<p>As relating to your industry, explore issues relating to anatomy and physiology.</p> <p>Skeletal system- study the bones of the arm, hand, and neck. Research carpal-tunnel syndrome.</p> <p>Fractures- identify the types of fractures and those most common to your line of work. Learn how to prevent falls.</p>
<i>Understand</i> basic principles of Ecology.	<p>Define ecology.</p> <p>Identify 5 major ways in which man interacts with the environment, especially as relating to your industry.</p> <p>Discuss the effectiveness of the media as compared to pro-science groups (such as Greenpeace) on the public's awareness of important environmental issues.</p> <p>Identify any areas of concern regarding waste/waste management in your industry.</p> <p>Show the difference between a niche, community, habitat, and ecosystem.</p> <p>Give examples of herbivores, carnivores, and omnivores. How does your industry use and serve each group?</p> <p>Understand predators' effects on food chains. Identify predators of industry.</p> <p>Explain the process of decomposition and decay. How does industry interfere with or interrupt these processes?</p>
<i>State</i> the differences between viruses and bacteria.	<p>Define viruses and bacteria.</p> <p>Explore viral and bacterial threats present in the workplace. How can they be prevented? How can they be treated?</p> <p>State the benefits of viruses and bacteria.</p>

	Explain the recent increased resistance to drugs and antibiotics.
<i>Understand</i> basic concepts relating to plants.	<p>Describe the interchange of oxygen and carbon dioxide between plants. Contrast to the way humans exchange oxygen and carbon dioxide.</p> <p>As relating to industry, review the concepts of: Fertilization Parts of plant, and functions of each Effects of temperature on plants Need for water and light Photosynthesis</p>
EARTH SCIENCE	
<i>Recognize</i> earth's position in the universe.	<p>As relating to your industry, identify relevant topics regarding Asteroids Comets Stars Galaxies</p> <p>Identify planets in the solar system.</p> <p>Compare and contrast earth to other planets.</p> <p>Create a model showing the relative size of earth within our solar system. Use mathematical relationships to make sure the scale is correct (earth is the size of ____ so the sun should be the size of ____).</p> <p>How do the phases of the moon and sun affect the hemispheres?</p>
Investigate history of the earth.	<p>Identify geological, chemical and other methods of determining the age of an object.</p> <p>Demonstrate that fossils and rocks are indicators of previous eras.</p> <p>As a class, create a timeline indicating the age of the earth. Include the various ages (Ice Age, etc) and the length of each.</p> <p>Make sure the timeline is drawn to scale.</p>

	<p>Assign each Age to a group and research the following:</p> <p>Weather</p> <p>Major events at beginning and end of age</p> <p>Organisms living during this time</p> <p>Factors that made the Age unique</p>
<i>Investigate</i> physical characteristics of the earth.	<p>Label/model the components of the earth.</p> <p>Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles of gravity.</p> <p>Solve problems of longitude, latitude and time zones.</p> <p>Create a model of the ratio of land and water on earth.</p>
<i>Investigate</i> physical forces acting on the earth.	<p>Examine erosion and depletion of nonrenewable resources.</p> <p>Identify natural disasters such as hurricanes and earthquakes. Research the effects of a past disaster on a specific industry.</p> <p>Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles of plate tectonics (the earth's surface is broken into large plates; movements of these plates over time causes earthquakes and other geologic activity).</p>
<i>Explain</i> the basic components of earth's rotation.	<p>Understand that the earth spins on its axis at an angle of 23 ½ degrees</p> <p>Identify the period of one complete rotation as a day; longer cycles of rotations identify the seasons.</p> <p>Discuss time zones.</p>
<i>Identify</i> the earth's atmosphere and its components.	<p>Identify the main elements in the earth's atmosphere (nitrogen and oxygen).</p> <p>Identify layers of the atmosphere, and the ozone layer.</p>

	Explain concepts of air pressure.
<i>Understand</i> basic principles of the solar system.	Demonstrate how the sun strikes the earth at different angles depending on location.
<i>Demonstrate</i> the relationship between climate and weather.	<p>Identify the factors that create weather.</p> <p>Show how landscape features are affected by changes in climate or weather.</p> <p>Identify the greenhouse effect. How does industry contribute to it?</p> <p>Describe the relationship between altitude and weather.</p> <p>Understand that changes in the weather may be seen as fronts that are put in motion by the jet stream.</p> <p>Identify types of precipitation.</p> <p>Differentiate between types of clouds.</p> <p>Understand the effect of winds, wind speeds, and impacts on vegetation.</p>
<i>Learn and apply</i> concepts relating to the oceans.	<p>Label the major oceans and seas.</p> <p>Determine the elements in ocean water (nearly all elements are present).</p> <p>Identify or draw the structural components of the ocean floor.</p> <p>Explain the relationship between the moon and the tides.</p> <p>Explore ways the ocean is used for power and business.</p>
<i>Investigate</i> principles of water.	<p>Identify the parts of the water cycle and the effects of the processes involved.</p> <p>Define water's chemical properties water is the universal solvent water has a neutral ph of 7</p>

	<p>chemically, water is one atom of oxygen bound to two atoms of hydrogen)</p> <p>Measure salinity. Which industries rely heavily on water?</p> <p>Define water's physical properties water is the only natural substance that exists as solid, liquid, and gas water's surface has a high density water has a high tolerance for heat (heat index) water's weight water as a coolant specific gravity</p>
<i>Investigate conservation of physical and natural resources.</i>	<p>As relating to your industry, discuss or debate the issues of Allocation of resources Recovering resources Best/worst methods of using resources</p> <p>Compare/contrast renewable and nonrenewable resources.</p> <p>Note the important developments in your industry regarding mineral, soil, water, and wildlife conservation.</p> <p>Discuss alternative sources of energy as relating to your industry.</p>
<i>Investigate issues regarding scientific technology.</i>	<p>As relating to your industry, discuss the uses of technology. What are the newest developments?</p> <p>What effects does the technology have on our society? Political system?</p> <p>Discuss the role of economics on technology.</p>
<i>Apply science principles/laws to environmental issues.</i>	<p>Discuss how mankind alters the earth and environment through use of resources and technology, pollution.</p>

Crosswalk to Skills USA–VICA

Industrial Equipment Maintenance

Student organization information correlates to course content. Student organization activities enable students to apply and practice competencies as they master them. Course curriculum in the Arkansas Industrial Equipment Maintenance framework, when combined with skills gained in other Technical and Industrial Education courses or occupational experience, corresponds to the following SkillsUSA–VICA contests and championship technical standards. Teachers may use this information as a basis for a crosswalk between contest standards and state and local competencies for Industrial Equipment Maintenance.

Contest: Automated Manufacturing Technology

- Performing Mathematical and Measurement Calculations
- Designing, Sketching, Planning Machine Work
- Create Tool path (CAM file), CNC Code
- Perform CNC Machining Functions
- Inspection of Part TQM Process

Contest: Heating, Ventilation, Air Conditioning, and Refrigeration

- Job Estimating
- Install and Service Refrigeration Systems
- Install and Service Controls
- Install and Service Mechanical Components
- Install and Service Refrigeration Specialties
- Diagnose and Problem Solve
- General Heating Systems

Contest: Industrial Motor Control

- Safety
- Use of Tools and Equipment
- Calculations
- Trade Information
- Install Raceways and Enclosures
- Install and Connect

Contest: Mechatronics

- Build to Print
- Mechatronic System Troubleshooting
- Written Exam
- Oral Exam

Contest: Precision Machining Technology

- Machining-Related Computational Competencies (Inch and Metric)
- Professional Development Competencies
- Communication Competencies
- Physical Science Competencies
- Safety and Hygiene Competencies
- Manual Turning (Lathe) Operation Competencies
- Manual Milling Machine Operation Competencies
- Manual Drill Press Competencies
- Manual Grinding Machine Competencies
- Bench and Hand Tool Competencies
- Process Control and Measurement Competencies
- Power Sawing Competencies
- Machinability Knowledge Competencies
- CNC Milling Programming Competencies

- CNC Turning (Lathe) Programming Competencies
- CNC Machine Setup and Operation Competencies
- Flexible Manufacturing Systems and New Technologies Knowledge Competencies

Contest: Sheet Metal

- Layout and Development of Various Sheet Metal Problems Using the Principles of Parallel Line Development, Radial Line Development, and Triangulation Development
- Fabricate and Install Mechanical Systems
- Fabricate and Install Architectural/Roofing Sheet Metal
- Fabricate and Install Specialty Sheet Metal

Contest: Welding

- Safety
- Measurements
- Blueprint Reading
- Shielded Metal Arc Welding (SMAW)
- Gas Metal Arc Welding (GMAW)
- Fluxed Cored Arc Welding (FCAW)
- Gas Tungsten Arc Welding (GTAW)
- Oxygen Fuel Cutting (OFC)
- Plasma Arc Cutting (PAC)

Further information may be accessed through the SkillsUSA–VICA web site (<http://www.skillsUSA.org/>), where the technical standards for all SkillsUSA Championships may be purchased.

Arkansas's All Aspects of Industry

Defining “All Aspects”

All aspects of an industry include, with respect to a particular industry that a student is preparing to enter, planning, management, finance, technical and production skills, underlying principles of technology, labor and community issues, health and safety, and environmental issues related to that industry. Planning is examined at the level of both an individual business and the overall industry. Planning elements might include:

- Developing strategic plans — mission, vision, goals, objectives, and/or a plan of action
- Working with planning tools such as surveys, market research, and competitive analysis
- Anticipating needs for staffing and major purchases of equipment and supplies
- Developing plans for training and upgrading of staff
- Forecasting market trends
- Developing business plans for entrepreneurial ventures.

Management addresses methods typically used to manage enterprises over time within the industry, as well as methods for expanding and diversifying workers' tasks and broadening worker involvement in decisions. Key elements of management might include:

- Using an organization chart to explain how a corporate chain of command works
- Providing input for strategic plans and communicating the company's vision and mission statements
- Leading employees in carrying out strategic plans and action plans
- Evaluating employee performance
- Anticipating technology and other major purchasing needs
- Ensuring equity and access for employees
- Resolving conflicts
- Developing job descriptions and written policies/procedures
- Identifying recruitment procedures, training opportunities, methods of evaluation, and retention strategies
- Working with professional associations and community outreach efforts.

Finance examines ongoing accounting and financial decisions and different methods for raising capital to start or expand enterprises. Finance functions might include:

- Developing budgets
- Preparing financial statements
- Analyzing and managing financial transactions and records
- Implementing payroll procedures
- Determining and paying taxes
- Identifying indirect wage costs (benefits, FICA, insurance, worker's compensation)
- Making loans and granting credit to customers
- Developing graphs and charts related to company finances
- Identifying and implementing methods of sustaining profitability of a business
- Managing 401K plans
- Identifying sources of capital

Technical and Production Skills cover specific production techniques and alternative methods for organizing the production work, including methods that diversify and rotate workers' jobs. Technical and production skills that an employee should have to succeed in a business or industry might include:

- Developing and upgrading job-specific skills
- Using troubleshooting and problem-solving techniques
- Analyzing information to make decisions
- Identifying and implementing quality assurance techniques
- Employing communication skills such as writing, listening, speaking, and reading
- Participating in team efforts
- Implementing projects and new techniques
- Demonstrating basic computer skills; employing time management techniques in completing projects and assigned tasks
- Demonstrating ethical behavior and work ethic.

Underlying Principles of Technology provide an integrated study across the curriculum of the mathematical, scientific, social, and economic principles that underlie the industry's technology.

Principles of technology that an employee should know might be demonstrated by:

- Exhibiting proficiency in mathematical and scientific functions related to new and emerging technologies
- Continuously upgrading job skills needed to implement new technologies
- Participating in industry certification programs
- Cross-training to enhance one's value to the organization and to enhance job promotion opportunities
- Understanding and adhering to ethical issues related to technologies.

Labor Issues examine worker rights and responsibilities, labor unions and labor history, and methods for expanding workers' roles. Labor issues might include:

- Understanding and implementing worker rights and responsibilities
- Working with labor unions
- Keeping abreast of local, state, and federal legislation affecting employee and employer rights and responsibilities
- Negotiating and settling worker disputes
- Identifying certification requirements for specific jobs
- Analyzing the impact of labor agreements on business operations.

Community Issues explore the impact of the industry on the community and the community's impact on and involvement with the industry. Concepts of business and community relations might include:

- Developing and working with community outreach projects
- Participating on advisory committees and community organizations
- Working with professional associations
- Developing and implementing public relations plans
- Participating in community service projects.

Health, Safety, and Environmental Issues examine these concepts in relation to both the workers and the larger community. Concepts related to health, safety, and the environment might include:

- Identifying and implementing federal, state, and local regulations related to the health and safety of employees
- Understanding and strictly adhering to federal, state, and local environmental regulations related to the business
- Identifying job-specific health hazards and safety issues
- Identifying and implementing basic safety and first aid training techniques for emergencies such as personal illness or injury, tornadoes, fires, nuclear accidents, floods, and incidences of employee-rage or violent behavior
- Communicating safety regulations and plans to employees

Working with selected community groups to implement safety programs.

Industrial Equipment Maintenance Framework Cross Reference

Industrial Equipment Maintenance I

Unit 1	Applied Math and Precision Measurement	Duty(s): B
Unit 2	Reading and Dimensioning Blueprints	Duty(s): A, H
Unit 3	Basic Symbols	Duty(s): H
Unit 4	Industrial Safety	Duty(s): A
Unit 5	Metallurgy	Duty(s): C
Unit 6	Energy and Power	Duty(s): D
Unit 7	Fasteners and Holding Devices	Duty(s): C
Unit 8	Purchasing Parts and Maintenance	Duty(s):
Unit 9	The Metal Lathe	Duty(s): C, D, F
Unit 10	Vertical Milling Machine	Duty(s): C, D, E
Unit 11	Abrasive Processes	Duty(s): C, D
Unit 12	Drilling Machines	Duty(s): C, D
Unit 13	The VICA Student Organization	Duty(s): J

Industrial Equipment Maintenance II

Unit 1	Pneumatics	Duty(s): D
Unit 2	Hydraulics	Duty(s): D
Unit 3	Electricity	Duty(s): D
Unit 4	Welding	Duty(s): G
Unit 5	Sheet Metal	Duty(s):
Unit 6	Construction Maintenance	Duty(s):
Unit 7	The VICA Student Organization	Duty(s): J